Environmental Management at Washington State National Security Facilities

Washington State Department of Ecology
Hazardous Wastes and Toxics Reduction Program
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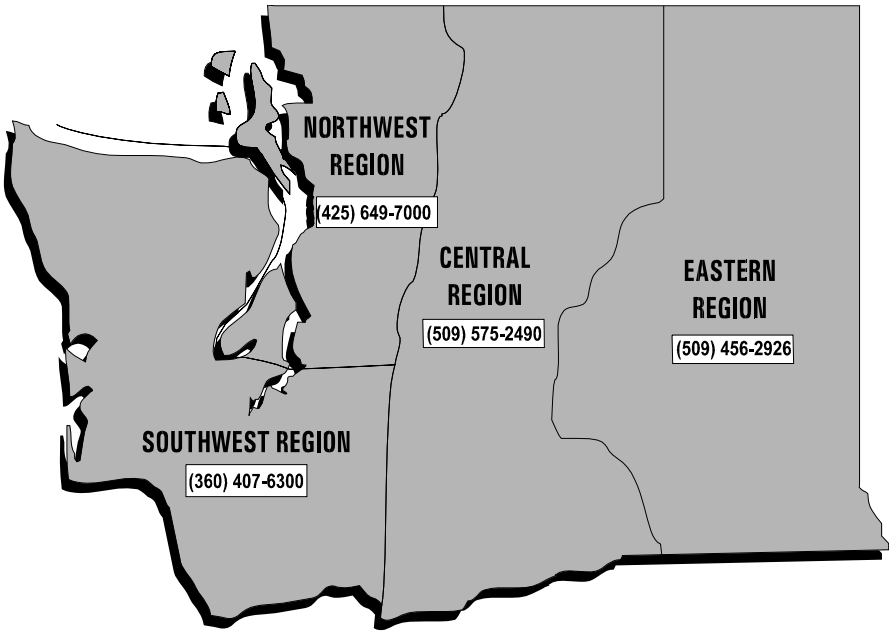

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Environmental Management at Washington State National Security Facilities

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I. Executive Summary

From 1997 to 1999 the Washington State Department of Ecology's Hazardous Waste and Toxics Reduction Program conducted an evaluation of the 22 national security facilities located in Washington State. This evaluation was an effort to provide a summary of the environmental programs, challenges and accomplishments of these facilities as a sector. This sector includes the federal Departments of the Army, Navy, and Air Force, as well as the state-led Washington Army National Guard and Washington Air National Guard.

Key topics covered in this report are:

- ✔ General information about the sector
- ✔ National security facilities history of compliance in environmental matters
- ✔ The typical industrial processes found in this sector and what pollution prevention opportunities are available
- ✔ Conclusions and recommendations for this sector and Ecology staff

(Note: This report focuses on pollution prevention and hazardous waste management activities and does not specifically address all air, water and clean-up operations.)

All of the facilities assessed in this report continually improved their approaches to reducing detrimental impacts to the environment. For example, facilities have displayed remarkable reduction in waste generation - results displayed in Section V indicate over a 50% reduction in the generation of Dangerous Waste from 1990 to 1999. Extremely hazardous waste was reduced by over 90% during the same time period.

Pollution Prevention Plans indicate that the national security facilities continue to implement new ways of reducing waste every year. In addition, the use of hazardous substances has decreased dramatically through the use of Authorized Use Lists and strict inventory management procedures

As a result of the evaluation, Ecology staff developed the following recommendations which may continue to benefit these national security facilities as they strive to meet their environmental goals:

- ✔ Continue to develop their Environmental Management Systems
- ✔ Continue to communicate regularly with Department of Ecology staff
- ✔ Continue to regionalize environmental activities
- ✔ Focus on reducing waste streams with largest potential environmental impact
- ✔ Continue to put a high priority on environmental programs

II. Overview

The National Security Sector includes the Departments of the Army, Navy and Air Force and the other associated defense agencies, as well as the Washington Army National Guard and the Washington Air National Guard. There are almost two dozen installations in the State of Washington (see following table), and thousands of installations across the U.S.

National Security Facility	County
US Air Force - Fairchild Air Force Base	Spokane
US Air Force - McChord Air Force Base	Pierce
US Army - HQ I Corps & Fort Lewis	Pierce
US Army - HQ Vancouver Barracks	Clark
US Army - Yakima Training Center	Yakima
US Navy - US Naval Radio Station, Jim Creek	Snohomish
US Navy - US Naval Station, Everett	Snohomish
US Navy - Bangor Submarine Base	Kitsap
US Navy - NUWC Division, Keyport	Kitsap
US Navy - Naval Air Station, Whidbey Island Ault Field	Island
US Navy - Naval Air Station, Whidbey Island Seaplane Base	Island
US Navy - Naval Ordnance Center, Port Hadlock Detachment	Jefferson
US Navy - Puget Sound Naval Shipyard	Kitsap
Washington Air National Guard - Camp Murray	Pierce
Washington Air National Guard - Everett 215th EIS	Snohomish
Washington Air National Guard - Seattle	King
Washington Army National Guard - Camp Murray	Pierce
Washington Army National Guard - Mobil Training Equipment	Yakima
Washington Army National Guard - OMS #4	Lewis
Washington Army National Guard - OMS #9	Spokane
Washington Army National Guard - Unit Training Equipment Site	Pierce
Washington Army National Guard - Army Aviation Support Facility #1	Pierce

Table 1: National Security Facilities in Washington State

Installations range in size from a few acres to thousands of square miles. Many of these installations are the equivalent of small, and sometimes not so small, cities. As a result they often have the entire infrastructure of a city including hospitals, sewage treatment plants, roads and airports.

Each national security facility is charged with defending the interests of the United States. Their missions range from logistics and training, to manufacturing and rebuilding aircraft and ships. These facilities provide the necessary infrastructure to support the armed services to meet their missions.

Much of the support activity associated with national security facilities is industrial in nature. As a result, facility installations confront a variety of environmental issues, including air and water pollution and the generation of solid and hazardous waste.

Examples of commercial and industrial activities commonly conducted at national security facilities include:

- ✔ Maintenance of vehicles, vessels and aircraft (including painting and parts cleaning)
- ✔ Fuel storage and refueling
- ✔ Electroplating
- ✔ Printing and photoprocessing
- ✔ Wastewater treatment
- ✔ Hospital operations
- ✔ Laboratory research
- ✔ Office operations
- ✔ Explosives manufacturing, storage, and disposal
- ✔ Electronics facility maintenance
- ✔ Ship building
- ✔ Land management
- ✔ Warehousing

The major hazardous wastes generated by national security facilities in Washington State in 1999 were:

- ✔ Wastewater
- ✔ Petroleum wastes
- ✔ Electroplating wastes
- ✔ Equipment retired from service that designates as a hazardous waste
- ✔ Paint Wastes

To help determine areas where Ecology staff could best provide pollution prevention assistance, staff compiled waste generation data on these major wastestreams from each facility. The results of the analysis can be found in Appendix A which begins on page 10.

III. Compliance Strategies

All federal facilities, including national security facilities, are required to comply with various statutes, regulations, and executive orders administered by the Environmental Protection Agency (EPA). These executive orders direct the environmental management approaches taken by the national security facilities. Executive orders issued for federal facilities mandate:

- ✔ Cleanup of contaminated federal property
- ✔ Creating and implementing effective environmental strategies that emphasize compliance, risk management, pollution prevention, and sustainable development
- ✔ Acquiring resources for developing and improving environmental management systems (e.g. adequate budget, human resources, information management systems, and technology)
- ✔ Addressing issues related to environmental justice
- ✔ Addressing the need for preservation of land and ecosystems

Recognizing the unique nature of the national facilities sector, EPA and Washington State have joined together to create coordinated federal facility enforcement and compliance assurance requirements, and currently provide assistance to facilities as they follow those requirements.

The Federal Facilities Multimedia Enforcement Compliance Program (FMECP) is a national program designed to use multimedia inspections to assess the compliance of federal facilities with environmental laws. Under the program, each of EPA's ten regional offices conducts a series of multimedia team inspections, in concert with the appropriate state officials.

Under Executive Order 12873, all federal agencies have been ordered to establish or strengthen existing recycling programs. Some local success stories include:

- ***McChord Air Force Base** which has captured an estimated 40 percent of its waste through its paper, aluminum, and glass recycling program.*
- ***Whidbey Island Naval Air Station-Ault Field**, **Bangor Submarine Base** and **Puget Sound Naval Shipyard** were recipients of the Secretary of Defense Environmental Security Recycling Award*

Between 1990 and the present, FMECP inspections conducted at a number of high-risk national security facilities throughout the State of Washington resulted in few enforcement actions being issued. The actions that were taken ranged from warning letters to formal administrative orders that included penalties.

Enforcement of a statute or regulation involves whatever judicial and administrative actions (both civil and criminal) are available to the state or federal government when a facility is not in compliance, such as orders and/or penalties.

Although assessment of penalties sends an important and strong deterrent message to the regulated community, penalties are not the only means of enforcing environmental goals.

Supplemental Environmental Projects (SEPs) are environmental projects and other measures which can reduce assessed penalties. Negotiated with Washington State and/or EPA, the size of a penalty can be reduced in exchange for agreements by the facility to complete environmentally beneficial projects. These agreements are enforced and must go beyond the injunctive relief EPA or Washington State could otherwise order.

The following is an example of a Supplemental Environmental Project carried out by the Navy:

In 1997 a $30,000 penalty was issued to Puget Sound Naval Shipyard (PSNS) for illegal disposal of lead-bearing waste in a landfill. In lieu of part of the penalty, PSNS requested that they be allowed to perform a shoreline enhancement project to rehabilitate beach spawning beds for salmonids and smelt at the Navy Manchester Fuel Depot. The penalty was renegotiated to allow $24,000 to be used for the project and a payment of $6,000 was made to the regulatory agency. Field work for the project was completed in June, 1999.

IV. Innovative Environmental Programs

National security facilities are involved in numerous innovative environmental programs and have formed several successful environmental partnerships with EPA. Environmental programs underway at national security facilities include:

- ✔ Fast-Track Cleanup Program to speed the cleanup process at military bases slated for closure
- ✔ Development and adoption of pollution prevention strategies
- ✔ Revision of all material specifications and standards with their environmental effects in mind
- ✔ Evaluation of the environmental effects of all major systems being acquired
- ✔ Continuous reductions in hazardous waste generation
- ✔ Environmental Technology Programs to coordinate and integrate environmental research and development
- ✔ Implementation of Environmental Management Systems in accordance with ISO 14000

A Puget Sound Naval Shipyard (PSNS) employee, Bill Boucher, was recognized as a Navy Individual Environmental Achievement Award winner in 1998 for his efforts to eliminate oil spills from both the Navy Fleet and from PSNS. There have been numerous spills of petroleum products by naval vessels in Washington state waters from 1993 to the present. In order to minimize the potential for spills from aircraft carriers about to undergo maintenance work, PSNS decided to educate crewmembers prior to entering Washington State waters. Since PSNS implemented this preventative approach, the number and volume of the spills from aircraft carriers have been reduced dramatically.

In addition to the prevention of vessel spills, the number of reportable oil spills from PSNS shore-based operations has decreased from 26 spills in 1995 to four spills in 1998. The total gallons of oil spilled have also decreased markedly, from 2,600 gallons in 1995 to 37 gallons in 1998.

Government Wide Initiatives

As a result of executive orders and other directives, many federal agencies have introduced significant changes in their daily operations. These changes address goals such as reducing emissions from fossil fuels, purchasing environmentally preferable products, and implementing environmental justice strategies. A few of the programs and initiatives underway that involve the national security sector are described below.

Strategic Environmental Research and Development Program

The Strategic Environmental Research and Development Program (SERDP) is a multi-agency effort which involves the Department of Defense (DOD), Department of Energy (DOE) and EPA's science and technology program. The aim of SERDP is to enhance technology transfer with the private sector. More than 35 percent of the projects conducted under SERDP involve partnerships with industry.

Federal Agency Environmental Roundtable

Fifty federal agencies are represented on the Federal Agency Environmental Roundtable. The Roundtable exchanges information on policy, strategy, standards, and regulations. Topics of discussion include the hazardous waste docket, proposed EPA strategies for national programs, technical information systems, and military base closures.

Federal Facilities Environmental Restoration Dialogue Committee

The Federal Facilities Environmental Restoration Dialogue Committee is an advisory committee under the Federal Advisory Committee Act. Its purpose is to provide a forum to identify and refine issues related to environmental restoration activities at federal facilities. Its members include:

- ✔ Several federal agencies including EPA, DOD, National Oceanic and Atmospheric Administration (NOAA), and the Agency for Toxic Substances and Disease Registry (ATSDR)
- ✔ National and local environmental, citizen, and labor organizations
- ✔ Tribal governments and Native American organizations
- ✔ State government agencies and state government associations

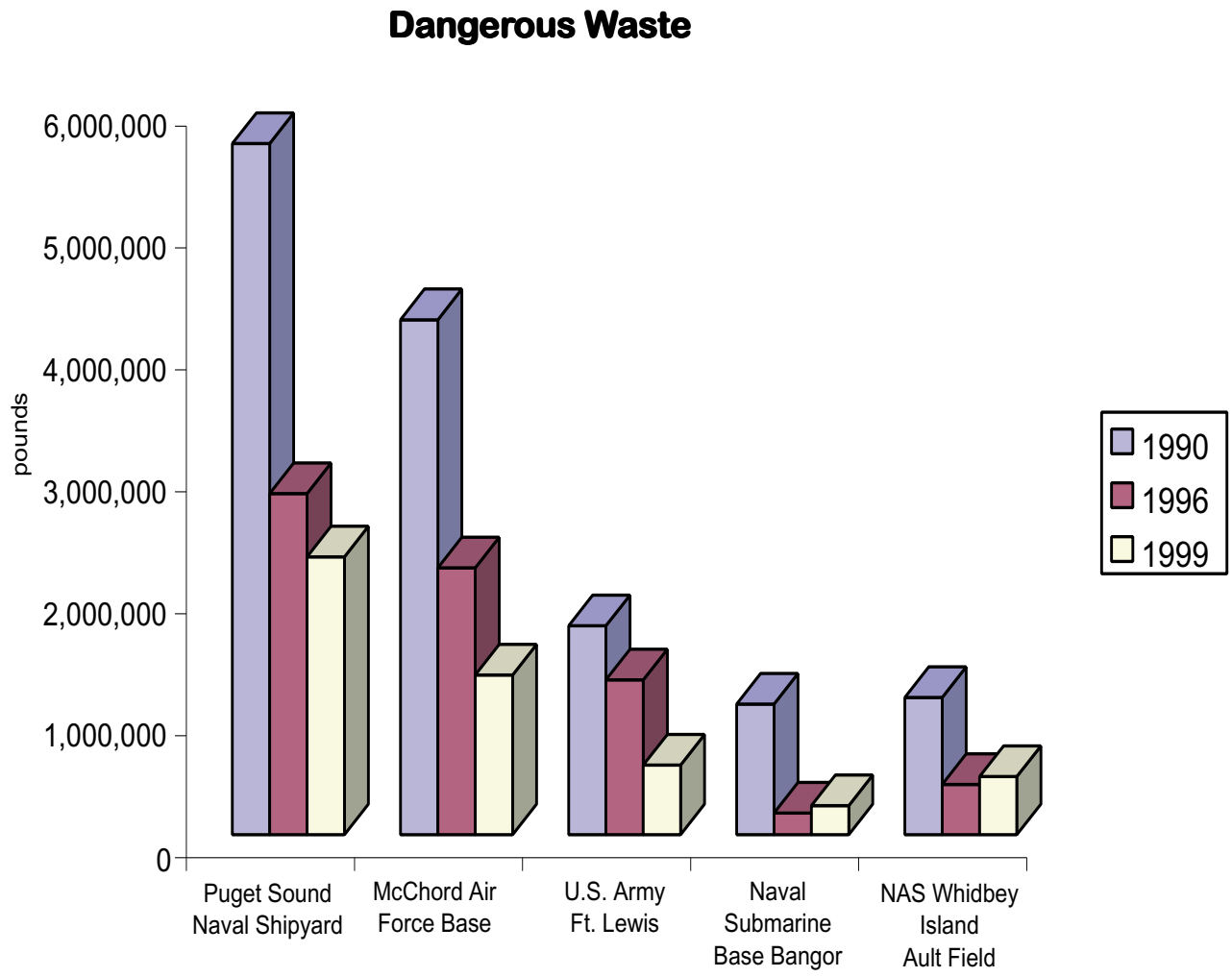
Environmental Justice

In 1994, President Clinton issued Executive Order 12898 entitled 'Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations'. The concept of environmental justice means that all people have an opportunity to live in a healthy environment, breathe clean air, drink clean water, and consume uncontaminated foods.

This executive order directs all federal agencies to develop environmental justice strategies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations. The order also established an Interagency Working Group on Environmental Justice, which is chaired by EPA. Member agencies of the working group include DOD, US Department of Housing and Urban Development (HUD), United States Department of Agriculture (USDA), and several civilian agencies, including the Council on Environmental Quality and National Aeronautics and Space Administration (NASA).

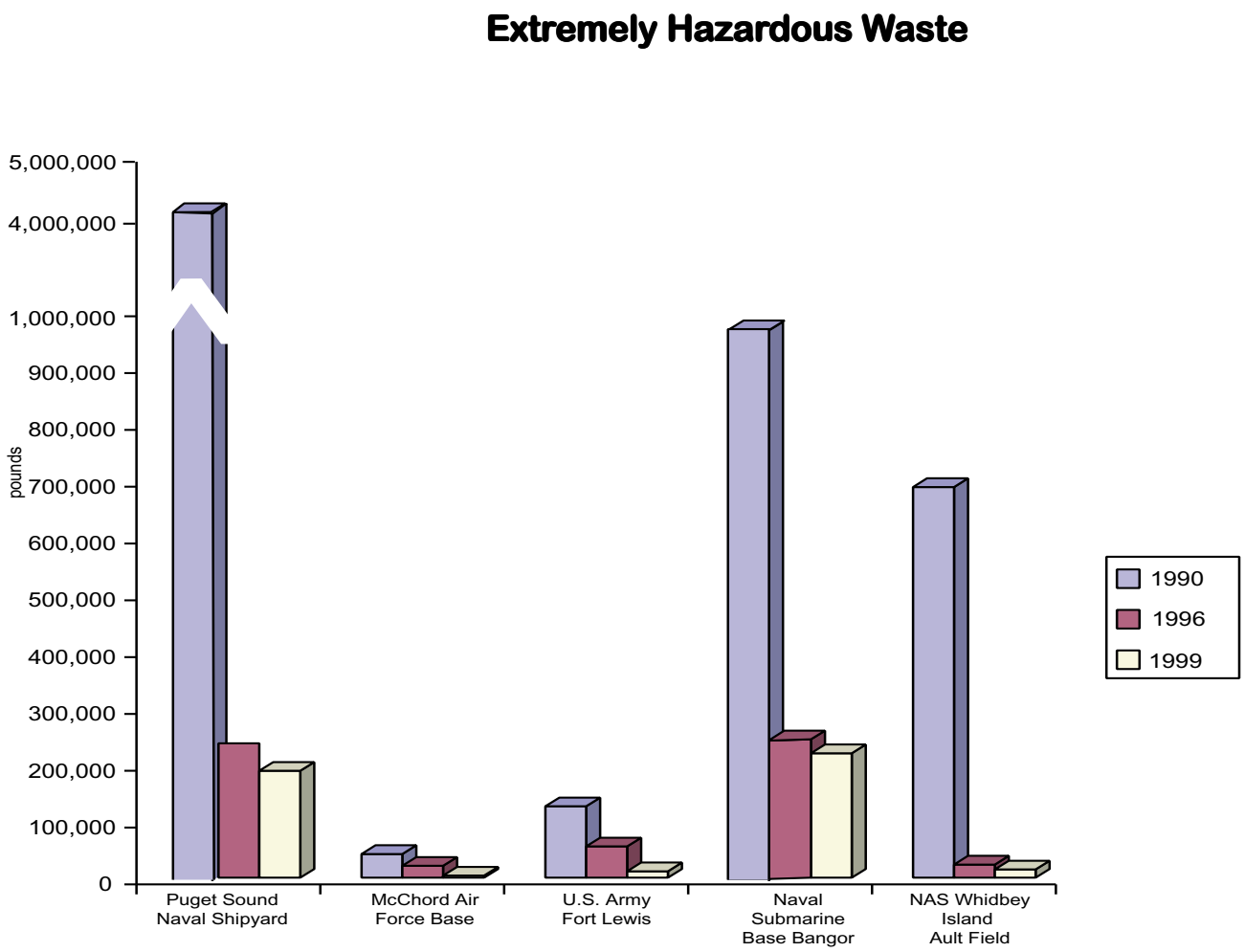
V. Pollution Prevention Progress

The following graph depicts the reduction in Dangerous Waste that has occurred between 1990 and 1999 at each of the larger national security facilities in Washington State.



Note: 1990 totals are an estimate based on available information. 1996 and 1999 totals hve been verified, and do not include non-recurrent wastes, TSCA wastes or wastewater treated on-site.

Extremely hazardous waste generated at these facilities during this same time has also been substantially reduced between 1990 and 1999 as depicted in the following graph.



Note: 1990 totals are an estimate based on available information. 1996 and 1999 totals have been verified.

VI. Conclusions and Recommendations

The national security facilities have made major progress in the area of environmental management. This is evident through their dedication to compliance with environmental laws and regulations, their implementation of Executive Orders, and their overall environmental performance. All of the facilities assessed in this report continually improve their position in regards to environmental impact. For example, they have displayed remarkable reductions in their waste generation. The results displayed in the graphs in Chapter VI indicate over a 50% reduction in the generation of Dangerous Waste from 1990 to 1999. Extremely hazardous waste was reduced by over 90% during the same time period.

An analysis of Pollution Prevention Plans indicates that the facilities continue to implement new opportunities to reduce waste and the use of hazardous substance every year.

The following recommendations may be of benefit to these facilities as they continue to strive to meet their environmental goals:

- **Enhance development of Environmental Management Systems**
  An Environmental Management System approach to pollution prevention planning and environmental compliance in general allows each of the facilities to apply limited resources to the most beneficial projects.

- **Continue to communicate regularly with Department of Ecology staff**
  Some of the larger installations have been having bi-monthly meetings with staff from the Department of Ecology. This level of communication has provided the regulatory and facility personnel with increased insight and awareness to assist in accomplishing their environmental goals.

- **Continue to regionalize environmental activities**
  Some of the environmental requirements of the Department of Ecology and EPA may be more efficiently managed from a centralized location. Regionalization allows the facilities to share expertise, improve auditing functions, provide for more favorable contract administration, conduct various types of training and results in an improved overall effectiveness in meeting environmental goals.

- **Focus on reducing waste streams with the largest potential environmental impact**
  Several very large waste streams are recurrent among national security facilities. It would be in everyone's best interest to address these waste streams and develop suitable reduction goals. (See Appendix B for Pollution Prevention Opportunities.)

- **Continue to put a high priority on environmental programs**
  While the national security facilities in Washington have had numerous successful pollution prevention implementation projects and their environmental programs are continuing to improve, the momentum needs to continue. The challenge to improve is an arduous one. It will require innovation, commitment and resources.

Appendix A: Recurrent Dangerous and Extremely Hazardous Wastes Sent Off-Site in Calendar Year 1999 by National Security Facilities That Are Required to Prepare Pollution Prevention Plans

The following graphs depict the amounts and types of the major wastes generated in 1999 by Washington's larger Navy, Army and Air Force installations.

USN PSNS Bremerton

Total lbs	Description
373,364	HYDRAULIC FLUIDS, NON RCRA (USED)
294,620	POTASSIUM CHROMATE SOLUTION
268,767	TRANSDUCERS/HYDROPHONES W/RCRA METALS
181,183	ABRASIVE BLASTING DUST W/METALS AND DEBRIS
93,938	PAINT SLUDGE FROM HYDROBLASTING HULL OF CARRIER

USARMY HQ I Corps & Fort Lewis

Total lbs	Description
96,556	FUEL OIL #2, TANK BOTTOM FLUID AND SLUDGE
76,197	PAINT CHIPS AND DEBRIS FROM WINDOWS AND DOORS CONTRACT [LEAD]
44,689	ABSORBENT PADS WITH FUELS [JP-8 OR DIESEL] AND OILS
29,319	OIL/WATER SEPARATOR LIQUID FROM DRMO SCHREDDER
23,276	OXYGEN CANDLES (BARIUM PEROXIDE, SODIUM CHLORATE)

USN Bangor Submarine Base

Total lbs	Description
38,727	SLUDGE/IWPTP MHT (TOXIC)
33,880	SANDBLAST GRIT (TOXIC)
23,971	DEBRIS/HEAVY METAL (FLAMMABLE)
21,974	ETHANOLAMINES MIXTURE (CORROSIVE)
21,292	DEBRIS, FLAMMABLE/NON TCLP/NON F LISTED

USN WHIDBEY

Total lbs	Description
186,481	AIRCRAFT RINSATE
117,909	CONTAMINATED RINSATE
16,678	WASTE FO-606 PAINT REMOVER
15,349	AQUEOUS PARTS WASHER RINSATE
15,334	CONTAMINATED ABSORBENT (CONTAMINATED SPEEDY DRY)

USAFB McChord

Total lbs	Description
1,229,760	AIRCRAFT WASH WATER WITH METALS
24,020	PAINT BOOTH WATERFALL WATER [N070375]
18,260	COMBUSTIBLE LIQUID; NON-RCRA (WASHRACK TROUGH SLUDGE, OILS & GREASES)
11,312	SILVER; SILVER RECOVERY WASTE LIQUID [N61203]
5,221	FUEL MIX; GASOLINE, DIESEL, AVIATION, 2 CYCLE OIL [FL075]

USARMY Yakima Training Center

Total lbs	Description
9,922	ABSORBENT PADS WITH FUELS [JP-8 OR DIESEL] AND OILS
4,143	BATTERIES, LEAD-ACID, GEL CELL [SULFURIC ACID]
3,458	OIL CONTAMINATED WITH WATER [OIL 1-60%, WATER 40-90%]
2,834	JP-8 FUEL [KEROSENE], OFF SPECIFICATION [<15% WATER]
2,801	ANTIFREEZE MIXTURE, USED, WITH [40% ANTIFREEZE, 30% WATER, 20% DEBRIS,

USARMY Vancouver Barracks

Total lbs	Description
6,215	SAND WITH LEAD, VANCOUVER BARRACKS
772	PAINT CHIPS AND DEBRIS FROM WINDOWS AND DOORS CONTRACT [LEAD]
147	IMPREGNATION KIT, M3, CONTAINER #1
44	OIL CONTAMINATED WITH ANTIFREEZE (ETHYLENE GLYCOL), VANCOUVER
20	DECON KIT, TRAINING, M58A [IPA]

USAFB Fairchild

Total lbs	Description
4,332	FLAMMABLE SOLIDS (SPILL PADS,CONTAMINATED W/JP-8)
3,315	HAZARDOUS WASTE, SOLID (PAINT BOOTH DEBRIS)
2,869	WASTE PAINT
2,130	BLASTING GRIT
2,044	PHOTOGRAPHY WASTE (FIXER SOLUTION)

NUWC Keyport

Total lbs	Description
261,778	WATER AND OIL (WATER >51%)
58,681	OTTO FUEL AND SOLVENTS (FP<141)(CADMIUM, LEAD)
56,461	OTTO FUEL WASTEWATER (FLASHPOINT < 141F)
31,401	WASHWATER WITH OIL, COOLANT, HOCS
28,167	BLASTING RESIDUE W/METALS (SODA)

Naval Station Everett

Total lbs	Description
36,641	BLAST GRIT
9,431	HYDRAULIC FLUID
7,465	OILY RAGS WITH METALS
7,403	FLUORESCENT BULBS
5,645	BROMINE CARTRIDGE

Naval Air Station Whidbey-Seaplane Base

Total lbs	Description
9,654	PHOTO WASTE
2,405	ELECTRICAL EQUIPMENT "LIQUID"
1,111	CONTAMINATED ABSORBENT
1,012	SPENT SOLVENT
904	SODA LIME REAGENT

Naval Air Station Whidbey-Ault Field

Total lbs	Description
186,481	AIRCRAFT RINSATE
117,909	CONTAMINATED RINSATE
16,678	WASTE FO-606 PAINT REMOVER
15,349	AQUEOUS PARTS WASHER RINSATE
15,334	CONTAMINATED ABSORBENT (CONTAMINATED SPEEDY DRY)

Appendix B: Pollution Prevention Opportunities

This appendix provides examples of pollution prevention opportunities pertinent to each of the major operations present in national security facilities. Many national security facilities have already begun implementing these and other pollution prevention measures. The opportunities identified here represent a synthesis of the literature and include recycling and waste minimization in addition to pollution prevention.

Pollution Prevention Opportunities in Aircraft, Vessel, and Vehicle Maintenance

Used Oil

- Prevent spills through good housekeeping.
- Install special "oil extender" filters in vehicles.

Waste Antifreeze

- Substitute propylene glycol for ethylene glycol.
- Install on-site recycling equipment for waste antifreeze.

Air Conditioning Refrigerants

- Use on-site chlorofluorocarbon (CFC) recycling equipment.

Old Batteries

- Recycle.
- Maintain batteries according to operating direction.

Miscellaneous Wastes (tires, engine components, brakes, and gasoline)

- Recycle old tires.
- Use reformulated products (rebuilt components such as carburetors, and water pumps).
- Filter and reuse waste fluids.

Catalytic Convertors

- Recycle to recover precious metals.

Cleaning Operations

- Develop closed-loop systems for wash waters.
- Use wash waters from the final phase of cleaning in the initial phase.

Pollution Prevention Opportunities in Vapor Degreasing

Equipment Modifications

- Add peripheral condensing coils above the condenser coils to increase the thickness of the cold air blanket and prevent emissions from open-top vapor cleaners.
- Replace water in the freeboard condenser coils with a more efficient refrigerant.
- Add a water-cooled tank jacket to prevent convection of solvent vapors up the hot walls of the cleaning unit.
- Add a gravity solvent-water separator or a canister of desiccant to prevent or delay breakdown of the solvent, corrosion of degreasing equipment, and elevated emissions caused by accumulation of moisture.
- Ensure that the cover is manageable and tight-fitting so that it will be used regularly and be effective in preventing emissions.

Process Modifications

- To cause fewer emissions, use mechanical or ultrasonic cleaning. The effectiveness of ultrasonic cleaning is improved when solvents are heated to specific appropriate temperatures.

Material Substitutions

- Use aqueous cleaners, with or without added saponifiers, surfactants, detergents, agitation, pressure, alkalinity or heat.
- Use semi-aqueous cleaners (also known as emulsion cleaners) that incorporate hydrocarbon solvents and water into the cleaning and rinsing process.
- Use aliphatic hydrocarbon solvents, such as mineral spirits, naphtha, kerosene, and synthetic paraffinic hydrocarbons (especially appropriate in processes when contact with water must be avoided).
- Use miscellaneous organic solvents such as alcohols, ketones, and vegetable oils, that are less toxic solvents.
- Use catalytic wet oxidizers to provide oxidation of organic contaminants in the presence of water.
- Use absorbent medium cleaners, such as cleaning wipes composed of specialty fibers designed to remove oil and other contaminants.

Operational Modifications

- To reduce emissions caused by drag-out, withdraw parts from the degreaser when they stop dripping; hold parts in the freeboard zone until all parts are completely dry.
- To hold parts, use fixtures that promote better draining.
- Keep an idling degreaser covered.
- Slow the speed at which parts are moved; keep large cross-sections of parts 50 percent smaller than the corresponding degreaser section; and use sliding covers to reduce drafts and turbulence.
- Minimize the use of sprays; when necessary, use high pressure low volume spray heads; keep the spray nozzle below the cooling coils; and use short bursts of spray.
- Consider superheating the vapor to allow parts to dry quickly.
- Extend life of solvents through filtering and settling.

Pollution Prevention Opportunities in Painting Operations

Surface Preparation

- Minimize use of stripper.
- Use spent stripper as a rough pre-stripper on the next item.
- Consider the use of the following methods of stripping paint: dry ice pellets, abrasive media, plastic media bead-blasting, cryogenic, thermal, wheat starch media, and laser or flash lamp.

Operational Modifications

- Train spray gun operators in proper spray techniques to minimize generation of waste coating.
- Pre-inspect parts to ensure it is dry, clean and dust-free, and to prevent painting of obvious rejects.
- Schedule coatings to minimize color changes, or paint with lighter colors before darker colors to minimize the need for equipment cleanouts.
- Mix only as much coating as is needed for a job. Train employees to estimate amounts and mix paints correctly.
- Save off-color paint for other jobs.
- Apply extra coats to use excess paint.
- Avoid the need for re-coating by first inspecting the area to be painted.

Waste Segregation

- Segregate nonhazardous paint solids from hazardous paint solvents and thinner.
- Segregate solvent waste streams and avoid dilution with water.
- Separate solvents and foreign substances for recycling and reuse.
- Separate thinners from paint sludges by gravity separation and reuse them.

Material Substitutions

- Use powder coatings to eliminate VOC emissions and obtain high transfer efficiency.
- Use water-based coating to reduce solvent emissions.

Equipment Modifications

- Modify the spray booth to allow recovery and reuse of overspray solids.
- Size the paint cup on spray guns appropriately.
- Automate spray and dip operations when possible.
- Isolate spray booths for solvent-based coatings from spray booths for water-based coatings.
- Keep solvent soak tanks away from heat sources.
- Use high volume low pressure (HVLP) spray apparatus to increase transfer efficiency.

Equipment Cleaning

- Train employees to use only small amounts of solvents for cleaning.
- Flush equipment first with dirty solvent before final cleaning with virgin solvent, or pre-clean items with rags before cleaning with solvents.
- Use virgin solvents for final equipment cleaning, then reuse it as paint thinner.
- Consolidate solvent cleaning operations and use a multipurpose solvent.
- Reuse cleaning solvents for a resin system by allowing solids to settle out of solution.
- Use pressurized air mixed with a mist of solvent to clean equipment.
- Keep the washoff tank covered when it is not in use.
- Minimize dripping by tilting or rotating parts to drain as much solvent as possible and by allowing sufficient dry time.
- Use rags rather than disposable wipes whenever possible. Launder the rags in-house or locate a commercial laundry in the area that can provide the service.
- If disposable wipes are used, remove as much solvent from them as possible before disposing of them. Keep the used wipes and the spent solvent in separate containers.
- Use low-volume water cleaning systems.
- If possible, return coatings with expired shelf life to the manufacturer, sell them or use them as primer.

Pollution Prevention Opportunities in Fuel Storage and Refueling

Material Substitutions

- Substitute JP-8 jet fuel for JP-4.

Operational Modifications

- Sell fuels no longer useable under military specifications to civilian users.
- Maintain covers of above ground storage tanks to minimize infiltration by rainwater.
- Use non-lead based paints to paint above-ground storage tanks.
- Use high pressure low volume sprays for tank cleanout work.

Process Modifications

- Install recycling systems in environmental and runoff controls to remove waste fuel from wastewaters.

Pollution Prevention Opportunities in Electroplating

Material Substitutions

- Use water treated by deionization, distillation, or reverse osmosis instead of tap water.
- Consider hexavalent chromium alternatives and use of nonchelated process chemicals.
- Switch to noncyanide plating solution.

Process Modifications

- Extend the bath life through filtration, replenishment, electrolytic dumping, precipitation, monitoring, housekeeping, reduction of drag-in, purer anodes, and bags and ventilation and exhaust systems.
- Reduce process chemical drag-out by: minimizing concentrations of bath chemicals by maintaining chemistry at the lower end of the operating range; maximizing operating temperature of the baths to reduce viscosity; using setting agents to reduce surface tension of solution; maintaining racking orientations to maximize draining; withdrawing work pieces at slower rates to allow draining before rinsing; using air knives above process tanks; avoiding plating bath contamination of the plating bath; using drain boards between process and rinse tanks to route dripping fluids to process tanks; and using drag-out tanks to recover chemicals for reuse.
- Improve rinse efficiency of the rinse process through use of spray rinses and agitation of the rinse water, increased contact time; and countercurrent rinse systems, or flow controls. Reduce drag-in through better rinsing.
- Reuse bath or rinse water from one process in another, if compatible.
- Consider using spent process baths as pH adjusters.

Equipment Modifications

- Use purer anodes.
- Properly design and maintain racks.
- Install a bath filter to remove impurities.
- Replace cyanide-based plating solutions with cyanide-free solutions.

Metals Recovery Techniques

- Evaporate rinse water by heating it and reuse concentrated solution.
- Use reverse osmosis at high pressure, which allows water to pass through a membrane that retains metals, allowing return of the metal solution and use of the water as rinse water.
- Use ion exchange to recover metal ions in solution.
- Consider electrolytic recovery and electrowinning or electrodialysis.

Pollution Prevention Opportunities in Printing and Photoprocessing

Plate Making

- Use a countercurrent rinsing process during plate making.
- Reduce drag-in of contaminants and reduce drag-out of solution by adding dripboards and extending drip time.
- Monitor pH, temperature, and the strength of the solution frequently to extend bath life.
- Use direct-to-plate technologies whenever possible; these allow preparation of plates from computer images without intermediate steps.
- Eliminate metal etching or plating processes by substituting non-hazardous alternatives such as presensitized lithographic plates.
- Use floating lids on bleach and developer tanks.
- Use washless processing systems.

Fountain System

- Use waterless or dry printing whenever possible; it eliminates alcohol and fountain solutions altogether.

Ink System

- Prepare and use the precise quantity of ink needed for a press run.
- Cover all ink reservoirs or consider use of special non-drying aerosols that can be sprayed onto the ink system to prevent the ink from drying overnight or during shutdown, thus preventing the ink from becoming unusable.
- Purchase inks in containers that can be returned to the supplier for refilling, or order ink in small containers to avoid storage of large, partially-used containers.
- Choose water-based inks, radiation curing, soy-based inks, or inks that contain low levels of toxic metals.
- Use an automatic ink leveler.
- Recycle inks, either on-site or off-site. A common technique is the blending of various leftover color inks to produce black ink.

Cleaning System

- Use a separate container of solvent for cleaning each color unit; collect the solvent and use it again for that color.
- Adopt a standard ink sequence; doing so will eliminate the need to clean out the fountain solutions to change the ink rotation. Schedule light colors first to reduce equipment cleaning frequency.
- Clean the fountain solutions only when changing colors or when the ink may dry out between runs.
- Replace conventional hazardous cleaning solvents with less hazardous alternatives.
- Whenever possible purchase solvents from a company that will pick up and recycle the spent solvent.
- Reuse press wipes as long as possible. Use a dirty wipe for the first pass and a clean one for the second pass.
- Use rags rather than disposable wipes, whenever possible. Use a commercial rag cleaning business in the area that can provide the service.

Photographic Processing

- Extend lives of photo and film developing baths by adding replenishers and regenerators.
- Reduce the amount of waste containing silver by using films that do not contain silver.
- Reclaim and recycle silver from photochemical wastewater.
- Recycle photographic film and paper.

Pollution Prevention Opportunities in Hospital Operations

Pollution prevention opportunities at hospitals are somewhat limited by the practice of using disposables to prevent transmission of diseases and bacteria. However, many hospitals can benefit from the adoption of good management practices aimed at reducing or eliminating generation of waste. There are a number of general pollution prevention practices for hospitals . These include the following:

- Keep individual waste streams segregated.
- Centralize purchasing and dispensing of drugs and other chemicals.
- Test all new materials in small quantities before making bulk purchases.
- Provide spill cleanup kits and train staff appropriately.
- Inspect and maintain equipment to avoid leaks.
- Neutralize acid waste with basic waste.
- Use mechanical handling aids for drums to reduce spills.
- Use automated metering systems for laundry chemicals.

Chemotherapy

- Optimize drug container sizes when purchasing.
- Centralize chemotherapy compounding in a single location.
- Minimize waste from cleaning of the compounding hood.

Formaldehyde

- Minimize wastes from cleaning of dialysis machines and reverse osmosis (RO) units.
- Use reverse osmosis water treatment to reduce demands for cleaning of dialysis.
- Capture waste formaldehyde and consider its reuse in pathology or autopsy laboratories.

Photographic Chemicals

- Return off-specification developer to the manufacturer.
- Cover developer and fixer tanks to reduce evaporation and oxidation.
- Recover silver, waste film, and paper.
- Use squeegees to reduce bath losses.
- Use countercurrent washing.

Solvents

- Consider solvent substitutes.
- Reduce requirements for analytes.
- Use premixed kits for tests involving solvent fixation.
- Use calibrated solvent dispensers for routine tests.
- Recover or reuse solvents through distillation.

Mercury

- Substitute electronic sensing devices for devices that contain mercury.
- Recycle uncontaminated mercury wastes, using proper controls.

Waste Anesthetic Gases

- Employ low-leakage work practices.
- Purchase low-leakage equipment.

Pollution Prevention Opportunities in Research Laboratory Operations

Material Management

- Establish a centralized purchasing program.
- Order reagent chemicals in conservative but realistic amounts.
- Encourage suppliers of chemicals to become responsible partners (such as by accepting return of outdated supplies).
- Establish an inventory control program that traces chemicals from cradle to grave.
- Rotate chemical stock, using chemicals before expiration of shelf life.
- Develop a running inventory of unused chemicals for use by other departments, if possible.
- Perform routine self-audits.

Improved Laboratory Practices

- Segregate solvents and recycle them.
- When cleaning with solvents, reuse the spent solvent for the initial cleaning and use fresh solvent only for the final rinsing.
- Platinum, palladium, and rhodium contained in catalysts can be recovered through chemical procedures specific to certain metals. Segregation of these wastes for off-site recycling may be preferable.
- Investigate whether unused reagent chemicals and their containers can be returned to the manufacturer. The supplier may be able to resell sealed bottles of stable chemicals.
- Designate a facility or area for storage, segregation, and treatment of waste.
- Increase use of segregation of waste streams.
- Ensure that all chemicals and waste are identified clearly on containers.

Other Suggestions

- Design pollution prevention into proposals for research activities, and build in funding for proper waste management.
- Contact other labs before ordering chemicals and supplies to determine local availability, if possible.
- Determine sample quantities needed and alternatives to sample analysis.
- Expand use of microanalytical techniques.
- Educate procurement personnel to identify opportunities for material substitution.
- Explore the possibility of other uses for expired chemicals.

Pollution Prevention Opportunities in Wastewater Treatment Plant Operations

Many pollution prevention techniques for wastewater treatment strive to reduce the amount of wastewater being discharged from the source. Improvement of wastewater treatment systems can be an effective pollution prevention opportunity that often does not require significant modifications of processes or equipment. Many wastewater streams can be treated more effectively and economically if they are segregated from other streams that do not require the same degree of treatment. Highly contaminated wastewater streams, oily wastewater streams, and wastewater streams that contain contaminants that require specific treatment (e.g. removal of metals) can be segregated to reduce the volumes of wastewater undergoing certain treatment steps. Treatment of wastewater also can be improved by adding stages, such as: biological treatment, chemical precipitation, filtration, ion exchange, and sludge dewatering. These efforts should improve the effectiveness of the system and reduce treatment costs through reduction in the amount of sludge generated, recovery of metal for resale, and replacement of more costly treatment stages.

Below is a list of some pollution prevention options for reducing generation of wastewater:

Process Modifications

- Reuse process water, if possible.
- Prevent process water from leaking into noncontact cooling water or stormwater. Test storm sewer piping for leaks.
- Operate machinery at correct temperature and flow levels. Consider the use of automatic control and lock-out valves.
- Segregate wastewater streams that require different levels of treatment.

Rinse Water Conservation

- Install automatic flow controls or multiple rinse tanks in a countercurrent series system (the latter can reduce generation of wastewater by at least 90 percent).
- Use drag-out recovery techniques.
- Use sprays or mist to rinse off excess process solution, and agitate the rinse bath to increase its efficiency.

Cleaning System Modifications

- Schedule the use of similar chemicals together to reduce the need for cleaning.
- Maximize dedication of process equipment.
- Attempt to remove residue remaining in equipment to avoid the need for cleaning.
- Use process fluids to clean equipment, then recycle or blend them into the process stream.
- Use steam to yield a smaller volume of wastewater, and recycle the steam.
- Filter cleaning water to remove particulate and reuse water.
- Use compressed air to clean equipment or parts.

Treatment Alternatives

- Use treatment technologies that do not generate heavy metal sludges.
- Use different precipitating agents that can generate less sludge, such as caustic soda instead of lime.
- Maximize recovery of materials from wastewaters.
- Identify beneficial uses for sludge.

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